

THE SCIENCE AND PRACTICE OF CARIES PREVENTION, RISK ASSESSMENT, AND MANAGEMENT

Background Information

Credible scientific evidence recently has changed recommendations for diagnosis and treatment of dental caries. This position paper is intended to provide an evidence-based foundation for development of a new caries assessment, prevention, and treatment policy for the Idaho State University Department of Dental Hygiene.

Historical information has shaped the present day approach to management of dental caries in the vast majority of dental offices. The following points summarize commonplace knowledge and practice.

- Clinicians traditionally have relied on visual inspection, tactile examination with an explorer, and radiographic procedures for the detection of dental caries.
- The fact that dental caries is an infectious and a transmissible disease is well-known but not widely acknowledged. For example, the vertical transmission of *S. mutans* from mother to child is well-documented; however, few dental professionals modify the dental flora of pregnant women or mothers during the period of inoculation or advise mothers of this risk.
- We know that dental caries begins as a subsurface lesion and that meticulous oral hygiene and repeated fluoride applications will remineralize or reverse the lesion as long as the surface layer remains in tact. As a result, patients are counseled regarding the importance of these preventive/therapeutic procedures.
- Prevention of dental caries has relied on patient motivation and cooperation with interventions requiring significant lifestyle changes that are difficult to implement and often ignored.

Recent research has resulted in a major paradigm shift in etiology, prevention, assessment, and treatment of dental caries. During the past few years, cariology experts have convened to define the state of the science and to suggest mechanisms for influencing practice based on that evidence. One such group, the NIH Consensus Panel on Diagnosis, Treatment, and Management of Dental Caries published a summary of its findings in 2001 based upon expert testimony at a consensus development conference and a systematic review of the literature (1407 diagnostic studies and 1478 dental caries management studies). A few of its major findings follow, and a copy of the report is appended.

- The evidence did not support either the superiority of the visual or visual/tactile method of diagnosing caries; both are equally effective for clinical detection of dental caries.
- The panel concluded that use of sharp explorers to detect primary occlusal caries adds little diagnostic information and may be detrimental. (Note: Because reversing the caries process requires an intact enamel surface of the lesion, the typical use of a sharp explorer to check pits and fissures or white spot lesions often results in rupture of the surface layer.)
- Numerous in vitro and in vivo studies indicate that radiographs have diagnostic efficacy in detecting larger cavitated lesions and/or proximal lesions.
- The best indicators for increased caries risk are, first and foremost, past caries experience followed by inadequate exposure to fluoride, conditions that compromise good oral

hygiene, fermentable carbohydrate consumption, medical conditions or therapies that lower salivary flow rate, and any of these factors combined with presence of mutans streptococci.

- Strong documentation exists that the best primary preventive methods are acidulated phosphate fluoride gel applied 1 to 2 times a year, chlorhexidine use, and pit and fissure sealants so long as the sealants are maintained. Fair support exists for fluoride varnish, especially in permanent teeth. Neutral sodium fluoride is effective with low dose, high frequency applications (home) and no evidence supports professional two-part fluoride rinse efficacy.
- Sugarless products containing both sorbitol and xylitol are effective when combined with other strategies, and evidence is stronger for xylitol.
- Evidence regarding detection and prevention of root caries and secondary caries is weak.

The panel also stated that, “This is not to say that the diagnostic, preventive, and treatment techniques used do not work, but rather earlier studies to support their efficacy do not meet current scientific standards.” It also is apparent that gaps in evidence exist. Important conceptual shifts, however, have been strongly supported by rigorous science.

The most significant changes to embrace follow.

- Dental caries must be viewed as an infectious disease.
- The focus on noncavitated lesions provides the opportunity for more prevention and less surgical intervention despite current problems with diagnosis. Removal and restoration of cavitated lesions does not arrest or reverse the caries process; therefore, they should be coupled with antibacterial and fluoride therapies.

Application of the Evidence and the Paradigm Shift in Clinical Practice

Early Caries Detection

Pregnant women should have a dental exam and caries risk assessment during the second and third trimester. Examine caregivers and parents of babies and young children to ensure that caries is not starting or progressing. Look for white spot lesions, discolored pits and fissures, and radiographic or gross caries. Preventive and therapeutic interventions, education about the infectious nature of the disease, and identification of risk factors follows.

The use of a sharp explorer to probe occlusal pits and fissures is no longer recommended. In Europe, this technique is considered unethical because of the evidence of damage caused to the surface enamel layer. Additionally, studies have shown this method to have the lowest sensitivity and/or specificity when compared to radiographs and laser fluorescence. New caries detection technologies are emerging and laser fluorescence, although available, is not the best of upcoming technologies and is not widely used. In the meantime, an explorer may be used safely to remove bacterial biofilm or debris from a pit or fissure to enhance visual inspection, our initial prompt for exploration. Even with exploring, it is difficult to differentiate anatomical defects from incipient occlusal lesions. Radiographs with good contrast and diagnostic quality remain essential for diagnosis of lesions that have progressed to the thickness of the enamel. If the integrity of an enamel surface is intact and the radiograph indicates that the lesion has not penetrated the dentinoenamel junction, it can be reversed or arrested by remineralization and fluoride therapy, antimicrobial therapy, and/or pit and fissure sealants.

Caries risk assessment by means of a questionnaire or an interview is recommended to judge whether the patient is at risk for progression or initiation of dental caries. Caries risk warrants close monitoring and early prevention and intervention. For children 6 years and older through adulthood, high risk factors include visible or radiographic caries; caries restored in past three years; heavy plaque; frequent snacking (>3 x day) of sugars and cooked starch; hyposalivation medications, medical conditions, or medical treatments; visually inadequate salivary flow; dental or orthodontic appliances. Moderate risk factors include exposed roots, deep pits & fissures, incipient proximal radiographic lesions, white spot lesions or occlusal discolorations, and recreational drug use. Protective factors include fluoridated water supply, twice daily fluoride dentifrice use, fluoride rinse/gel daily, visually adequate salivary flow, xylitol gum or mint use 4 x day, and mother/caregiver without caries activity. A patient check sheet summarizing recommendations is a helpful adjunct. (See attached Featherstone article for specific protocol recommendations and examples of forms.)

Early Intervention/Therapy

The following antibacterial therapies are protective and/or therapeutic.

- Xylitol chewing gums/lozenges used 4 x day are effective anticaries therapeutic measures (e.g., mothers using xylitol gum during the first 2 years of their child's lives also leads to much lower caries in the children later).
- In hyposalivation cases, sodium bicarbonate (baking soda) rinses neutralize acids and have antibacterial properties.
- Chlorhexidine gluconate mouthrinse once daily for the first week of every month or for a 2-week period every two to three months for one year is effective against mutans streptococcus (not periodontal disease).
- Povidone iodine professionally applied every 2 months might reduce incidence of early childhood caries in high risk children.

The following fluoride delivery methods inhibit demineralization and enhance remineralization.

- Fluoridated drinking water
- Twice daily fluoride dentifrices (ADA-approved) and gels (0.04% Stannous fluoride; e.g., Gel Kam or Oral-B Stop)
- OTC fluoride rinses daily (0.05% sodium fluoride; e.g., ACT, Fluorigard, Listermint)
- Professionally applied APF or varnish followed by stannous fluoride
- For high risk adults, prescription high concentration fluoride gels and toothpaste (5,000 ppm fluoride – e.g., Prevident; 1.1% NaF gel – e.g., Oral-B Neutracare; 0.05% APF gel – e.g., Young Dental Karigel Maintenance; 0.2% NaF weekly rinses – e.g., Oral-B Fluorinse) coupled with prescription of chlorhexidine to overcome high bacterial challenge and allow efficacy of fluoride.

Biomaterials for minimally invasive treatment, conservation of tooth integrity, and inhibition of caries progression include the following.

- Pit and fissure sealants
- Fluoride-containing restorative materials including glass ionomer products.

Because all of these early detection and intervention methods can be delivered in the ISU Dental Hygiene Clinic and its focus is preventive in nature, the development of a new policy should encompass similar evidence-based approaches.

The Future

As new technologies for caries detection and intervention become more readily available, funding will be needed to provide students with state of the art education. A fee structure for a caries risk assessment and control program also should be considered. The curriculum must prepare graduates for transition into practice as well.

An Interim Educational Approach at ISU

The Idaho State University Department of Dental Hygiene recognizes the outcomes of the 2001 NIH Consensus Conference on Diagnosis, Treatment and Management of Dental Caries Throughout Life: Process and Outcome. As a result, the department supports caries risk assessment, early detection methods and conservative caries management strategies. Currently students are educated in methods for caries detection using radiography, visual and tactile assessments, caries risk assessment (caries risk policy), caries prevention strategies, and nonsurgical approaches to treating noncavitated lesions including antibacterial therapeutics (chlorhexidine gluconate), and topical fluoride (professionally applies foams and varnish; over-the-counter rinses, gels, and dentifrices and prescription topical fluoride gels and rinses).

The following is the procedure that dental hygiene students have been taught based on current scientific evidence and the department's current limited access to new technology.

Procedure for Caries Identification

1. Dry each tooth surface with compressed air to improve visualization. Also, when a dental hygiene faculty is assessing the dentition, the student clinician will assist with drying the tooth surfaces using four-handed dentistry methods.
2. Clinically/visually inspect each tooth surface (buccal, lingual, occlusal, proximal)
 - Visually first, then gently with explorer, only if indicated to remove plaque and debris to assist with visualization. Do not use heavy downward pressure with the point of the Shepherd's hook explorer, use the side of the point. Research has shown that the use of an explorer may cause iatrogenic damage to an early noncavitated lesion by breaking through the intact surface enamel and thus eliminate any chance for remineralization.
 - Use transillumination in the anteriors
 - During the clinical/visual inspection look for changes in color and translucency and/or breaks in the enamel surface
 - Chalky white areas of decalcification (white spot lesions)
 - Grayish-white, gray discolorations around marginal ridges and margins of restorations
 - Yellowish brown, brown discolorations in occlusal pits and fissures
 - Shadowing on proximal surfaces

- Black discoloration (arrested caries)
3. Use radiographs to assess presence of carious lesions
 - Bitewings are useful for detecting interproximal lesions.
 - Current standard
 - ✓ If an enamel lesion detected on the radiograph is not past the dentino-enamel junction, then it can be arrested or reversed by remineralization.
 - ✓ A radiolucency through the thickness of the enamel or into the dentin requires surgical (restorative) intervention followed by nonsurgical interventions (i.e. infection control (CHX), fluoride, etc.)
 4. New Technology in Caries Detection
 - Laser fluorescence, (e.g. Diagnodent)
 - Light fluorescence, (e.g. QLF)
 - Digital imaging fiber optic transillumination (e.g. DIFOTI)

Dental hygiene clinical faculty members and supervising dentists often continue to use traditional caries detection methods, and students are aware of this present day practice. Licensed practitioners are encouraged to discuss the differences in philosophies and approaches and their clinical experiences with students to resolve questions and to prepare them for practice challenges after graduation. Evaluation of students' caries assessment should take into account the interim approach that they have been taught; however, diagnosis and treatment planning is ultimately the responsibility of those professionals who are licensed to do so. The new department policy on detection, risk assessment, intervention, and therapy will reflect discussions within the various groups of faculty members. Development, therefore, will take time and patience. Your input and consideration will be appreciated.

REFERENCES

- Diagnosis and Management of Dental Caries Throughout Life. NIH Consensus Statement 2001 March 26-28; 18(1) 1-30.
- Featherstone, JDB, Adair SM, et al.: Caries Management by Risk Assessment: Consensus Statement. *CDA Journal* 2003 March; 31(3): 257-268.
- Barber LR, Wilkins EM: Evidence-based Prevention, Management, and Monitoring of Dental Caries. *J Dent Hyg* 2002; 76: 270-275.
- Stewart RE, Hale KJ: The Paradigm Shift in the Etiology, Prevention, and Management of Dental Caries: Its Effect on the Practice of Clinical Dentistry. *CDA Journal* 2003 March; 31(3): 247-251.
- Featherstone JDB: The Caries Balance: Contributing Factors and Early Detection. *CDA Journal* 2003 February; 31(2): 129-133.
- Featherstone JDB: Cariology in the New World Order: Moving from Restoration Toward Prevention. *CDA Journal* 2003 February; 31(2): 123-128.
- Guignon AN: Integration of a Laser Fluorescence Caries Detection Device in Dental Hygiene Practice. *Comendum* 2003; 24(5): 13-17.
- Stookey GK, Gonzalez-Cabexas C: Emerging Methods of Caries Diagnosis. *J Dent Educ* 2001; 65:1001-1006.

CLASSIFICATION FOR CARIES RISK

Table 1A

NEW CLIENTS AGE CATEGORY		
	Child/Adolescent	Adult
Low Risk*	No decayed, missing or filled surfaces (dmfs = 0)	No decayed, missing or filled surfaces (DMFS = 0)
Moderate Risk*	Past caries experience (dmfs >0) and/or 1 active lesion	Past caries experience (DMFS >0) and/or 1 active lesion
High Risk*	Past caries experience (dmfs >0) and/or 2 active caries or 1 smooth surface lesion	Past caries experience (DMFS >0) and/or 2 active caries or 1 smooth surface lesion

Table 1B

RECALL CLIENTS AGE CATEGORY		
	Child/Adolescent	Adult
Low Risk*	<ul style="list-style-type: none"> • No carious lesions in last year • Well coalesced pits & fissures • Good oral self-care • Appropriate fluoride use • Regular recall intervals 	<ul style="list-style-type: none"> • No carious lesions in last three years • Sound restorations • Good oral self-care • Regular recall intervals
Moderate Risk*	<ul style="list-style-type: none"> • 1 carious lesion in last year • Deep pits and fissures • Fair oral self-care • Inadequate fluoride intake • White spot lesions and/or interproximal radiolucencies • Irregular recall intervals • Current orthodontic treatment 	<ul style="list-style-type: none"> • 1 carious lesion in last three years • Exposed root surfaces • Fair oral self-care • White spot lesions and/or interproximal radiolucencies • Irregular recall intervals • Current orthodontic treatment
High Risk*	<ul style="list-style-type: none"> • ≥ 2 carious lesions in last year • Past history of smooth surface caries • Deep pits and fissures • Elevated mutans streptococci count • Little or no systemic/topical fluoride exposure • Poor oral self-care • Frequent sugar intake • Irregular recall intervals • Inadequate saliva flow • Inappropriate bottle feeding or nursing (infants) 	<ul style="list-style-type: none"> • ≥ 2 carious lesions in three years • Past history of root caries • Numerous exposed root surfaces • Deep pits and fissures • Elevated mutans streptococci count • Poor oral self-care • Frequent sugar intake • Inadequate use of topical fluoride • Irregular recall intervals • Inadequate saliva flow

*To assess which category is appropriate, assess past caries history to determine level of caries risk. If no caries activity is present, evaluate additional factors listed to determine the level of risk.

Adapted from JADA, Vol. 126, June 1995 Special Supplement

FLUORIDE POLICY

A primary role for the dental hygienist is to assist clients in oral disease prevention and health promotion. One agent used as an adjunct to caries prevention is fluoride. The Idaho State University Department of Dental Hygiene recognizes and supports the benefits of fluoride. The topical and systemic use of fluorides provide an effective method for the prevention and reduction of dental caries.

Fluoride use and availability have increased, making it difficult to estimate actual fluoride intake and/or topical exposure. Because fluoride can alter the aesthetic appearance of the teeth if ingested in excess amounts, the Department of Dental Hygiene has established guidelines to assure that fluoride is recommended based on a client's needs.

The Idaho State University Department of Dental Hygiene supports the following fluoride concepts:

1. Frequent topical exposure to low levels of fluoride is beneficial for people of all age groups.
2. A caries risk assessment will be completed to make the most appropriate recommendation for the type of fluoride to be used (See Table 1A and Table 2B).
3. A fluoride history will be taken to determine current exposure to fluoride. Both topical (OTC and prescription home fluoride rinses/gels, dentifrice's, dietary supplements, diet) and systemic (water supply, dietary supplements, diet) exposures should be assessed.
4. Following a fluoride history and caries risk assessment, recommendations will be offered based on the client's needs.
5. Prescriptions for topical fluoride agents or CHX may be issued through the ISU Dental Hygiene Clinic. Referral to the client's dentist for evaluation for future needs is recommended and encouraged.
6. Because of a reduction in caries rates and an increase in fluorosis rates, dietary fluoride supplements should not be routinely recommended for all children living in nonfluoridated areas. Instead, dietary fluoride supplements should be recommended for children in a moderate or high caries risk group. (Levy, Kiritsy & Warren, 1995)

Table 2		
FLUORIDE THERAPY RECOMMENDATIONS		
	Child/Adolescent	Adult
Low Risk	<ul style="list-style-type: none"> • Self-care education • Fluoride dentifrice - (pea-sized amount) (Avoid extra-strength brands) • Regular recare intervals • If Water F Level is ≤ 0.6 ppm, in-office fluoride application given (2x / year) (use caution to reduce ingestion) • If Water F Level is ≥ 0.6 ppm, in-office fluoride application is not recommended. 	<ul style="list-style-type: none"> • Self-care education • Fluoride dentifrice • Regular recare intervals • If Water F Level ≤ 0.6 ppm, in-office fluoride application given (2x / year) • If Water F Level is ≥ 0.6 ppm, in-office fluoride application is not recommended
Moderate Risk	<ul style="list-style-type: none"> • Self-care education (plaque removal & diet counseling with parents & client) • Fluoride dentifrice - (pea-sized amount) (Avoid extra-strength brands) 	<ul style="list-style-type: none"> • Self-care education (plaque removal, diet counseling) • Fluoride dentifrice
Pits & Fissures	<hr/> <ul style="list-style-type: none"> • Sealants 	<hr/> <ul style="list-style-type: none"> • Sealants
Smooth Surface and Root Caries	<hr/> <ul style="list-style-type: none"> • OTC home fluoride mouthrinse (0.05% NaF) (only for ≥ 6 years old & able to rinse/spit) • In-office fluoride application (2x per year) (use caution to reduce ingestion) • Fluoride supplements - assess fluoride history • Regular recare interval (no longer than six months) 	<hr/> <ul style="list-style-type: none"> • OTC home fluoride mouthrinse (0.05%NaF or 0.4% stannous gel) • In-office fluoride application (2x per year) • Regular recare interval (no longer than six months)
High Risk	<ul style="list-style-type: none"> • Self-care education (plaque removal & diet counseling with parents & client) • Fluoride dentifrice - (pea-sized amount) (Avoid extra-strength brands) 	<ul style="list-style-type: none"> • Self-care education (plaque removal, diet counseling) • Fluoride dentifrice
Pits & Fissures	<hr/> <ul style="list-style-type: none"> • Sealants 	<hr/> <ul style="list-style-type: none"> • Sealants
Smooth Surface and Root Caries	<hr/> <ul style="list-style-type: none"> • OTC home fluoride mouthrinse* (0.05%NaF) (only for ≥ 6 years old & able to rinse/spit) • In-office fluoride application (4x per year) (use caution to reduce ingestion) • Fluoride supplements - assess fluoride history • Antimicrobial mouthrinse (CHX rinse 2x per day/30 days) (only for ≥ 6 years old & able to rinse/spit) <p>Regular recare interval (3-6 months)</p>	<hr/> <ul style="list-style-type: none"> • OTC home fluoride mouthrinse/gel* (0.05%NaF or 0.4% stannous gel) • In-office fluoride application (4x per year) • Antimicrobial mouthrinse (CHX rinse 2x per day/30 days) • Regular recare interval (3-6months)

*When caries are present at recare appointment, prescription (high concentration) *topical gels or rinses are indicated.